

THE "CHALLENGER" IN THE ATLANTIC¹

THE *Challenger* left Portsmouth on December 21, 1872, and on the evening of May 24, 1876, she dropped her anchor at Spithead after an eventful voyage, which lasted three and a half years. Shortly after her arrival we gave a sketch of her cruise over the Atlantic and Pacific Oceans. The two volumes just published consist chiefly of an abstract of the less technical portions of the journal kept by Sir Wyville Thomson during the first year of the *Challenger's* voyage, and during the early part of the fourth year's voyage, when she was on her way home. During both these periods the *Challenger* was in the Atlantic, so that we now obtain the record of her survey of this great ocean in a very complete form, and are led to look forward to several additional volumes, in which the account of her cruise in the Pacific Ocean and amongst its fair islands will appear. A great deal of credit must be given to the author of these two splendidly illustrated volumes for his so speedily publishing them. A large portion of one of them was actually passed through the press while the *Challenger* was at sea, and the preparation of the second volume had to be carried on amid the cares not only of professional duties, but also of getting the immense collections made into order, and of making arrangements for the thorough working out of the scientific results of the voyage. May we express the hope that his energy will enable him speedily to complete the popular narrative of this cruise thus so auspiciously begun. The strictly scientific records of the *Challenger* voyage cannot be published for some time; the working out of old forms, the describing and illustrating of new ones, takes time; such work, to be done well, must necessarily be done slowly, and hence we all the more urge on Sir Wyville Thomson to let us have, as soon as can be, the completion of the popular narrative of the general results of his four years' work. This preliminary account is indeed not solely a popular one, for we find in these two volumes a mass of exact scientific details that will make them always works of reference to the scientific student; and while some few of the wondrous new species of animals and plants are but incidentally introduced to us, their descriptions are often so well written, and their forms are so exquisitely portrayed, as to leave us for the time somewhat independent of their more exact scientific diagnosis.

In our previous sketch of the voyage of the *Challenger* we dwelt somewhat in detail on the work accomplished by her during the first six months of 1873. About the middle of June in that year she left the Bermudas for the Açores and Madeira, establishing twenty-five stations on her way, some of these showing ocean depths of 2,800 fathoms. A few pleasant days were spent (July 1873) at Ponta Delgada, the capital of San Miguel and the chief town of the Açores. On account of the presence of an epidemic of small-pox no delay was made at Madeira, but the vessel's course was struck for the Canaries and Cape de Verde Islands, keeping somewhat parallel to the Coast of Africa until nearly opposite Cape Palmas, when they turned westward and shaped their course to Saint Paul's Rocks. These solitary rocks are nearly under the equator, midway between the coasts of Africa and of South America. They were visited in 1832 by the *Beagle*, and are noticed in Darwin's charming "Voyage of a Naturalist." Merchant-vessels usually give them a wide berth. They seem to have struck the travellers by their small dimensions; it being rather under

a quarter of a mile from the one end of the group to the other, they form quite little specks of rocks out in mid-ocean. Landing on these rocks was no easy matter. A loop of eight or ten ply of whale-line was passed round one of the rocks; to this a hawser was run from the ship lying about seventy yards out, with her bows in 104 fathom water; the hawser was made fast to the whale-line, and the ship thus moored to the rocks. Having landed on the rocks a line was laid across the mouth of the cove, which made the landing easier for the next parties.

Only two species of birds were found on the rocks, the "booby" (*Sula fusca*) and the "noddy" (*Sterna stolidus*), both being widely distributed birds on tropical islands and shores. They were here in enormous numbers, were quite tame, even allowing themselves to be taken up with the hand. The breeding season was over. No land plants were found, not even a lichen. The terns used a green alga to line their nests; all the crannies of the rock were crowded with an amphibious crab (*Grapsus strigosus*), which was much more wary than the birds, though "wherever a morsel of food came within their reach there was instantly a struggle for it among the foremost of them, and they ambled away with their prize wonderfully quickly: their singular sidelong gait and a look of human smartness about them had a kind of weirdness from its being exhibited through a set of organs totally different in aspect from those to which one usually looks for manifestations of intelligence."

Leaving these desolate rocks on August 29, the island of Fernando Noronha was in sight on September 1, rising like most of the ocean islands, abruptly from deep water, the depth of the ocean within six miles of the island being more than 1,000 fathoms. This island presents a most remarkable appearance; the land is generally not very high, but there is an irregular cliff which rises to a height of about 100 feet from the sea, succeeded by undulating land and conical hills, usually covered with luxuriant vegetation. The Peak is an extraordinary-looking mountain, formed of a column of rock which starts up to a height of 600 feet from a more or less level plateau of rock, itself some 400 feet above the sea. There is a village and a citadel, the place being a penal settlement belonging to Brazil. There were at the time on the island nearly 1,400 convicts and a garrison of 200 soldiers. The convicts enjoyed a considerable amount of liberty, each of them occupying a hut, and being allowed to cultivate a little piece of garden ground, though their time and labour from six in the morning until four in the evening belonged to the Government. Sir Wyville Thomson and his assistants were extremely anxious to investigate thoroughly the flora and fauna of this island, but unfortunately the military commandant set his face against this, and the land work had to be abandoned.

"The coast scenery was here and there very beautiful, little sandy bays with a steep cultivated slope above them, or a dense tangle of trees absolutely imbedded in one sheet of matted climbers, separated by bold headlands of basalt or trap stuff. Besides the tropic birds, there were to be seen beautiful little terns, snowy white, which usually flew in pairs a foot or two apart, one following all the motions of the other, like a pair of paper butterflies obedient to the fan of a Japanese juggler. They could be seen flying over the land, and often alighting upon the trees. The noddy was very common, and the booby was in considerable numbers. High upon the cliffs the nests of the frigate bird (*Tachypetes aquila*) could be seen, and from time to time these splendid birds moved in slow and graceful circles overhead." No wonder that the author adds, "We lay for some time below the cliffs admiring the wonderful wealth of animal and vegetable life ere we returned slowly to the ship."

On September 14, as they neared the coast of Brazil, a shower of butterflies fell on the ship, fluttering in multitudes over it; and over the sea as far as the eye

¹ "The Voyage of the *Challenger*. The Atlantic: a Preliminary Account of the General Results of the Exploring Voyage of H.M.S. *Challenger* during the Year 1873 and the Early Part of the Year 1876." By Sir C. Wyville Thomson, Knt., LL.D., F.R.S.S. L. and E., &c., Regius Professor of Natural History in the University of Edinburgh, and Director of the Civilian Scientific Staff of the *Challenger* Exploring Expedition. Two volumes. Published by Authority of the Lords Commissioners of the Admiralty. (London: Macmillan and Co., 1877.)

could reach they quivered in the air. Looking up into the sky where they were thickest, they were seen to be close together and had much the appearance and peculiar motion of large flakes of snow. Amidst such a down-pour the entrance to Bahia was seen. It is very beautiful; the coast is not elevated; it is neither mountainous nor hilly, but rises from the sea-shore in even terraces, broken here and there by ravines and wooden knolls, every space gloriously clothed with vegetation, and the sky-line broken by long lines of palm trees—from the sea it reminded one of Lisbon, but its splendid luxuriance of vegetation gives it a character of its own.

The scientific work of the *Challenger* was to be on the ocean, and Sir W. Thomson properly discouraged his staff from expending too much of their time or energies on investigating the natural history of the few spots of North or South America that they from time to time

landed on. We therefore in these volumes meet with very few references to the glimpses that they got of this continent, but some time had to be spent at Bahia, and we cannot avoid giving the following interesting extract which describes a visit made by Sir W. Thomson to Santo Amaro.

"Mr. Wilson was obliged to be next day at Sto. Amaro, a little town about thirty miles distant, across one of the ridges on another river where he had a line of steamers plying, and he asked us to ride there with him; so we went back to his house and dined, and spent the evening at his window inhaling the soft flower-perfumed air and gazing at the stars twinkling in their crystal dome of the deepest blue, and their travesties in a galaxy of fire-flies glittering and dancing over the flowers in the garden beneath us. It was late when we tossed ourselves down to take a short sleep, for two o'clock was the hour fixed to be in the

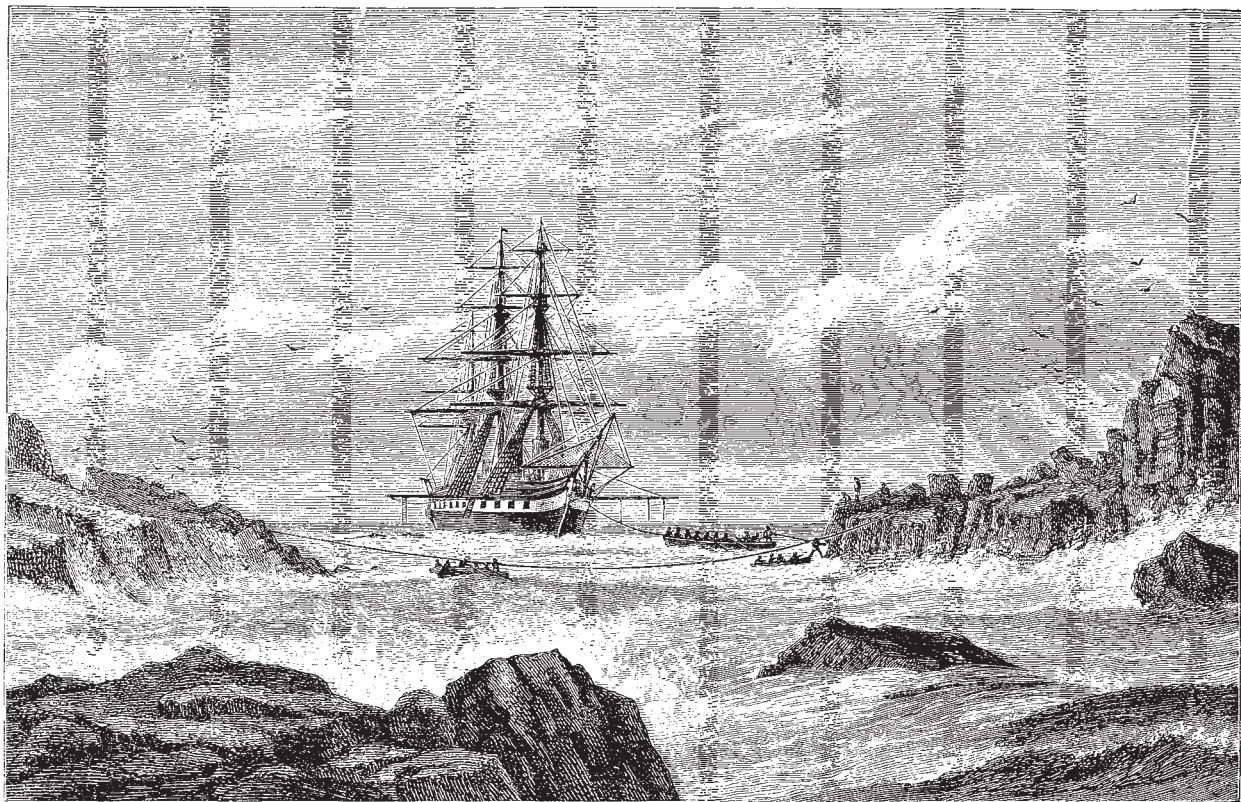


FIG. 1.—The *Challenger* at St. Paul's Rocks.

saddle in the morning. We rode out of the town in the starlight, Mr. Wilson, Capt. Maclear, and myself, with a native guide on a fast mule. We were now obliged to trust entirely to the instinct of our horses, for if a path were visible in the daylight there was certainly none in the dark, and we scrambled for a couple of hours right up the side of the ridge. When we reached the top we came out upon flat open ground with a little cultivation, bounded in front of us by the dark line of dense forest. The night was almost absolutely silent, only now and then a peculiar shrill cry of some night-bird reached us from the woods. As we got into the skirt of the forest the morning broke, but the *réveil* in a Brazilian forest is wonderfully different from the slow creeping on of the dawn of a summer morning at home, to the music of the thrushes answering one another's full rich notes from neighbouring thorn-trees. Suddenly a yellow light spreads upwards in

the east, the stars quick'y fade, and the dark fringes of the forest and the tall palms show out black against the yellow sky, and almost before one has time to observe the change the sun has risen straight and fierce, and the whole landscape is bathed in the full light of day. But the morning is for yet another hour cool and fresh, and the scene is indescribably beautiful. The woods, so absolutely silent and still before, break at once into noise and movement. Flocks of toucans flutter and scream on the tops of the highest forest trees hopelessly out of shot, the ear is pierced by the strange wild screeches of a little band of macaws which fly past you like the wrapped-up ghosts of the birds on some gaudy old brocade. There is no warbling, no song, only harsh noises, abrupt calls which those who haunt the forest soon learn to translate by two or three familiar words in Portuguese or English. Now and then a set of cries more varied and dissonant than

usual tell us that a troop of monkeys are passing across from tree to tree among the higher branches; and lower sounds to which one's attention is called by the guide indicate to his practised ear the neighbourhood of a sloth, or some other of the few mammals which inhabit the forests of Brazil. And the insects are now all awake, and add their various notes to swell the general din. A butterfly of the gorgeous genus *Morpho* comes fluttering along the path like a loosely-folded sheet of intensely blue tinsel, flashing brilliant reflections in the sun; great dark blue shining bees fly past with a loud hum; tree-bugs of a splendid metallic lustre, and in the most extraordinary harlequin colouring of scarlet and blue and yellow, cluster round a branch so thickly as to weigh it down, and make their presence perceptible yards off by their peculiar and sometimes not unpleasant odour; but how weak it is to say that that exquisite little being, whirring and flut-

tering in the air over that branch of *Bignonia* bells, and sucking the nectar from them with its long curved bill, has a head of ruby, and a throat of emerald, and wings of sapphire—as if any triumph of the jeweller's art could ever vie in brilliancy with that sparkling epitome of life and light.

"It was broad day when we passed into the dense forest through which the greater part of the way now lay. The path which had been cut through the vegetation was just wide enough for use to ride in Indian file, and with some care to prevent our horses from bruising our legs against the tree-trunks, and we could not leave the path for a single foot on either side, the scrub was so thick, what with fallen tree-trunks, covered with epiphytes of all descriptions, and cycads, and arums, and great thorny spikes of *Bromelia*, and a dense undergrowth, principally of melastomads, many of them richly covered with blue and

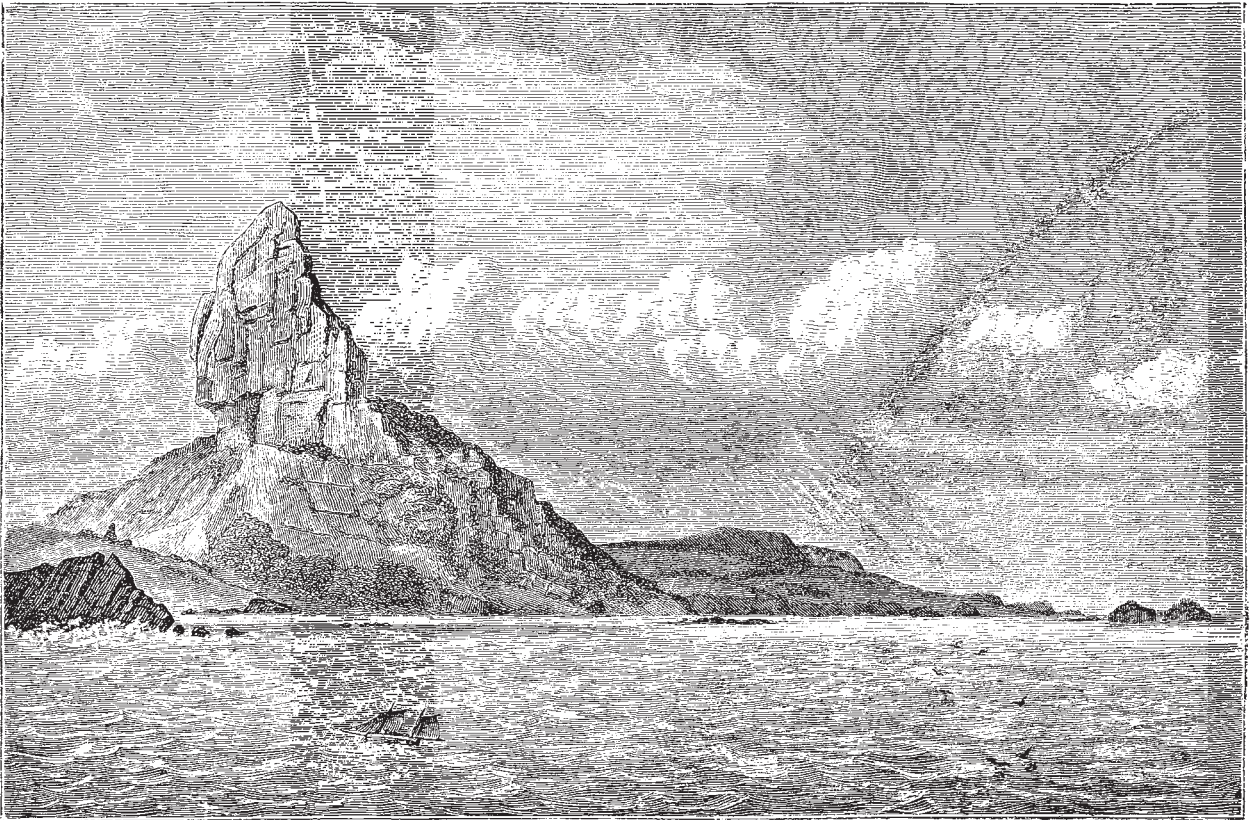


FIG. 2.—Fernando Noronha.

purple flowers. Above the undergrowth the tall forest trees ran up straight and branchless for thirty or forty feet, and when they began to branch, a second tier of vegetation spread over our heads, almost shutting out the sky. Great climbing *Monstera*s and other arals; and epiphytic bromeliads; and orchids, some of them distilling from their long trusses of lovely flowers a fragrance which was almost overpowering; and mazes of *Tillandsia* hanging down like tangled hanks of grey twine. Every available space between the trees was occupied by lianas twining together or running up singly, in size varying from a whipcord to a foot in diameter. These lianas were our chief danger, for they hung down in long loops from the trees and lay upon the ground, and were apt to entangle us and catch the horses' feet as we rode on. As time wore on it got very close and hot, and the forest relapsed

into silence, most of the creatures retiring for their noon-day siesta. The false roof of epiphytes and parasites kept off the glare of the sun, and it was only at intervals that a sheaf of vertical beams struck through a rift in the green canopy, and afforded us a passing glimpse of the tops of the forest trees, uniting in a delicate open tracery far above us.

"For some hours our brave little horses struggled on, sometimes cantering a little where the path was pretty clear, and more usually picking their way carefully, and sometimes with all their care floundering into the mud-holes, imperfectly bridged over with trunks of trees.

"As we had made our ascent at first, all this time we had been riding nearly on a level on the plateau between the two river valleys. Suddenly the wood opened, and we rode up to the edge of a long irregular cliff bounding

the valley of Sto. Amaro. The path ran right up to the edge and seemed to come to an end but for a kind of irregular crack full of loose stones which went zigzagging down to the bottom at an angle of about 70° , and we could see the path down below winding away in the distance towards the main road to Sto. Amaro. We looked over this cliff and told Mr. Wilson firmly that we would *not* go down the side of that wall on horseback. He laughed, and said that the horses would take us down well enough and that he had seen it done, but that it was perhaps a little too much; so we all dismounted, and put the horses' bridles round the backs of the saddles and led them to the top of the crack and whipped them up as they do performing horses in a circus. They looked over with a little apparent uneasiness, but I suspect they had made that precarious descent before, and they soon began to pick their way cautiously down one after the other, and in a few minutes we saw them waiting for us quietly at the bottom. We then scrambled down as best we might, and it was not till we had reached the bottom, using freely all the natural advantages which the *Primates* have over the *Solidunguli* under such circumstances, that we fully appreciated the feat which our horses had performed.

"The next part of the road was a trial; the horses were often up nearly to the girths in stiff clay, but we got through it somehow, and reached Sto. Amaro in time to catch the regular steamer to Bahia."

And here is an uncommonly good anecdote about a parrot:—

"At Sto. Amaro a line of tramways had lately been laid down also under the auspices of our enterprising friend, and we went down to the steamboat wharfs on one of the trucks on a kind of trial trip. The waggon went smoothly and well, but when a new system is started there is always a risk of accidents. As the truck ran quickly down the incline the swarthy young barbarians, attracted by the novelty, crowded round it, and suddenly the agonised cries of a child, followed by low moanings, rang out from under the wheels, and a jerk of the drag pulled the car up and nearly threw us out of our seats. We jumped out and looked nervously under the wheels to see what had happened, but there was no child there. The young barbarians looked at us vaguely and curiously, but not as if anything tragical had occurred, and we were just getting into the car again, feeling a little bewildered, when a great green parrot in a cage close beside us went through no doubt another of his best performances in the shape of a loud mocking laugh. A wave of relief passed over the party, but we were rather late, and the drivers expressed to the parrot their sense of his conduct, I fear strongly, but in terms which, being in Brazilian *patois*, I did not understand."

In another notice we will tell of the *Challenger's* doings between Bahia and Cape Town, and from the Falklands home, and we will also more particularly allude to the general results of the scientific work she has so successfully accomplished.

(To be continued.)

ON THE PRESENCE OF OXYGEN IN THE SUN

I HAVE spent the greater part of last winter and the beginning of this in an investigation of the spectra of oxygen. My experiments will be published, I hope, in another place; but there are one or two points of more immediate interest, and, I venture to think, of some importance, which I trust you will allow me to discuss in your columns.

Prof. Draper has lately announced the important discovery that the lines of oxygen are found to be present in the sun. These lines, however, are bright, and not dark, as the Fraunhofer lines. I had found that at a certain temperature, lower than that at which oxygen shows its

well-known lines, it gives another spectrum, and it occurred to me, when I heard of Prof. Draper's discovery, that if the temperature of the sun, at some point intermediate between the photosphere and the reversing layer was the same as that at which the spectrum of oxygen changes, the fact that the *known* spectrum of oxygen appears bright would be fully explained. The spectrum of lower temperature, which, for reasons to be given, I shall call the compound line spectrum of oxygen, ought in that case to be found reversed in the solar spectrum, like the remainder of the Fraunhofer lines.

I have consequently devoted all my time during three weeks to the exact measurement of these four lines, and I do not think that the evidence which I am about to give will be considered to fall far short of an absolute proof that the spectrum is really reversed in the sun.

Two difficulties have put themselves into the way of exact measurement. The first is due to the extreme weakness of the spectrum. The light itself is not stronger than that of a non-luminous Bunsen burner; and after that light has passed through four prisms, as in most of my experiments, or through seven, as in some of them, there is not much of a spectrum left to be measured. It is only after having been in the dark for half-an-hour that the eye is able to do the work, and there are a good many days when the eye never obtains sufficient sensitiveness to make any trustworthy measurements. But whenever my eyes were in sufficiently good condition, my measurements agreed so well, that I have no hesitation in saying that they are as accurate as the measurements of the solar lines which will be found by their side. The second and more serious difficulty is due to the fact that the lines in question widen to a great extent with increased pressure and in such a way that the brightest part, and still more, the centre of the band, is displaced towards the red. I have not been able to get the lines perfectly sharp, and the measurement of the centre of the band will give, therefore, too high a value of the wave-length. The following table contains the numbers which I have obtained:—

Oxygen.	Width.	Solar Lines.	
		A.	S.
α 6156.86	± 0.3	6156.70	6156.69
β 5435.55	± 0.3	5435.44	5435.56
γ 5329.41	± 0.6	5329.3	5329.10
δ 4367.62		4367.58	

The first column contains the wave-length of the compound line spectrum of oxygen. The second column contains the number which has to be added or subtracted from the wave-length, in order to get the edge of the lines, as it is their centres which are given in the first column. The third and fourth columns give the wave-lengths of the corresponding solar lines as observed by Angström (A.) or myself (S.). The greatest difference is found in the line γ , but even this difference only amounts to the twentieth part of the distance between the sodium lines, and it would require a spectroscope of very good dispersive power and definition to separate two lines which would be that distance apart from each other. Nevertheless the amount in question is greater than the possible errors of observation, and I believe the difference to be due to the fact mentioned above, that the lines widen unequally. It will be seen from the table that the solar line would fall within the oxygen line, but about one-third of the distance between its most refrangible and least refrangible edge. At a higher pressure the brightest part of the band lies about 5331. None of the other lines widen nearly as much, and δ is always perfectly sharp. Angström gives it as an iron line, but according to Kirchhoff, the solar line is composed of two lines, and separated by a distance of about 0.1.